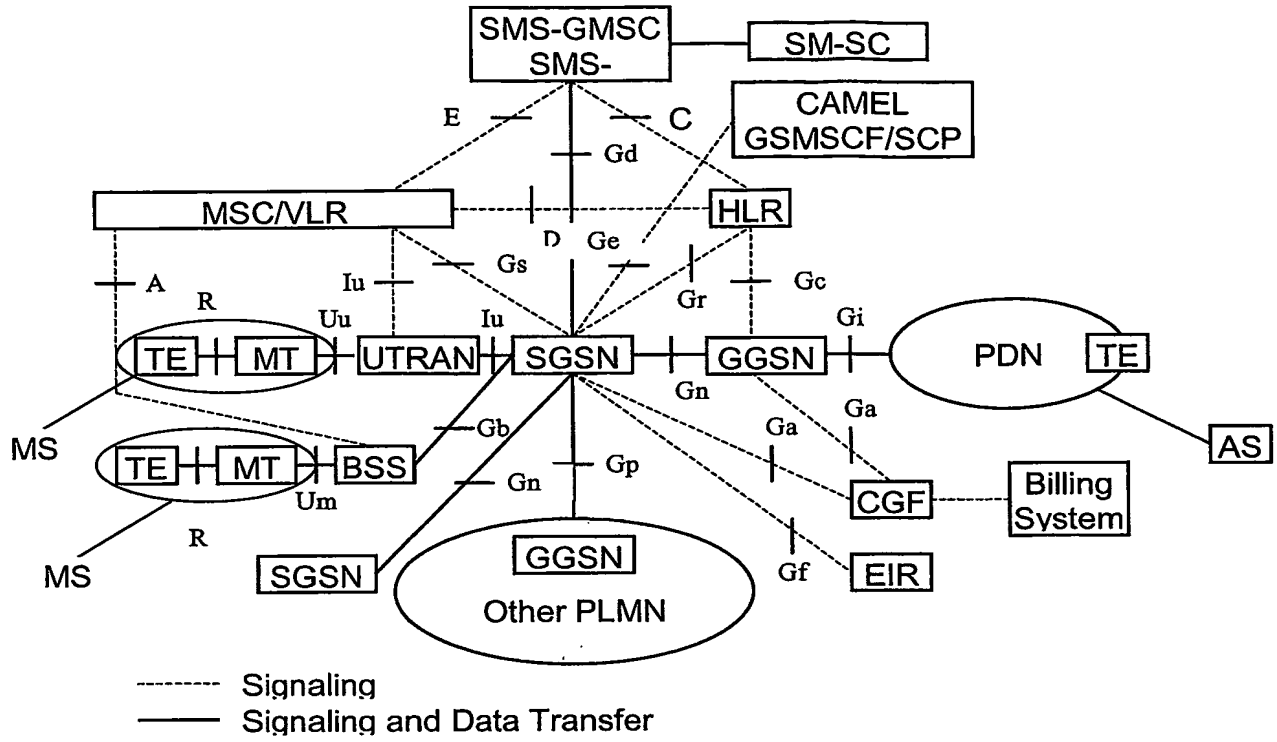


Fig. 1 prior art

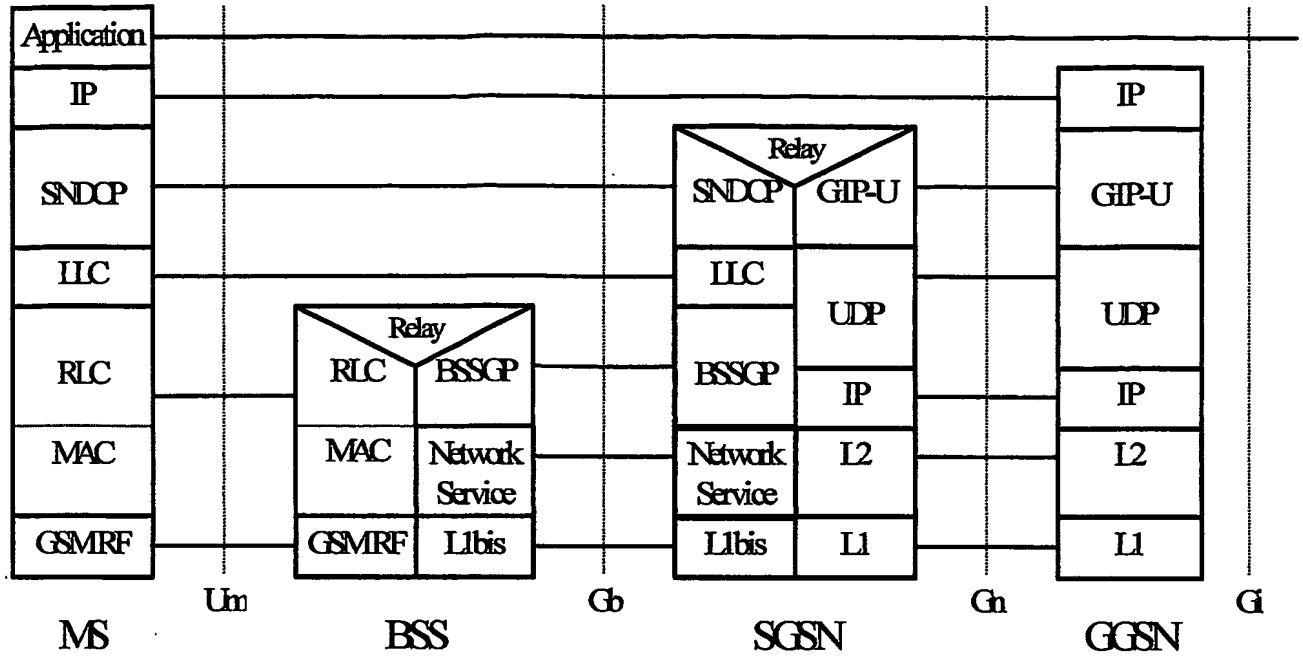


Fig. 2 – prior art

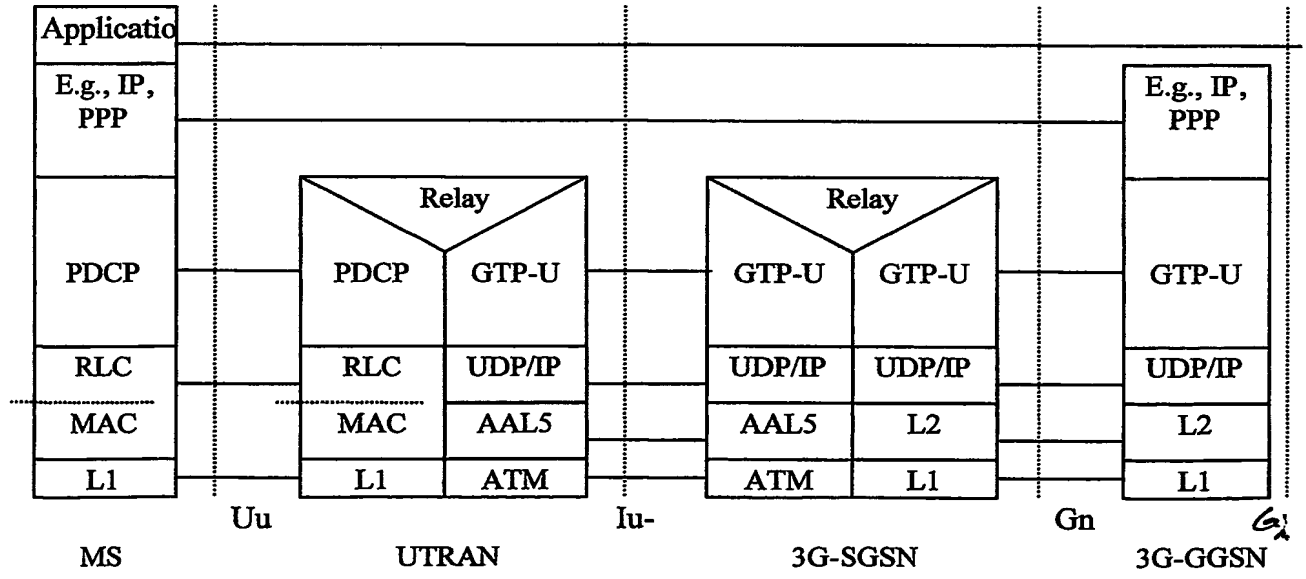


Fig. 3 – prior art

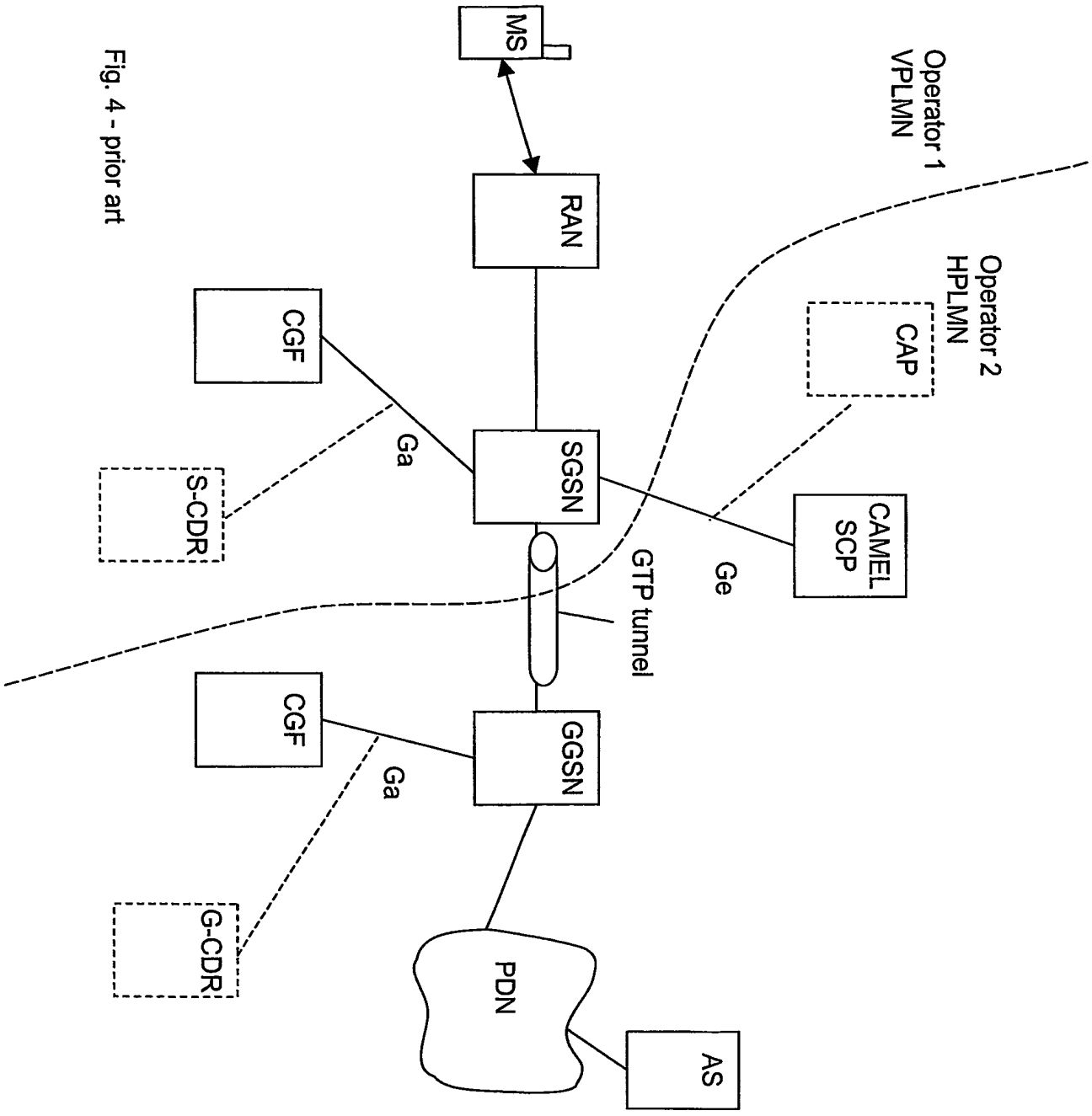


Fig. 4 - prior art

Octets	8	7	6	5	4	3	2	1
1	Version			PT	(*)	E	S	PN
2	Message Type							
3	Length (1st Octet)							
4	Length (2nd Octet)							
5	Tunnel Endpoint Identifier (1st Octet)							
6	Tunnel Endpoint Identifier (2nd Octet)							
7	Tunnel Endpoint Identifier (3rd Octet)							
8	Tunnel Endpoint Identifier (4th Octet)							
9	Sequence Number (1st Octet)							
10	Sequence Number (2nd Octet)							
11	N-PDU Number							
12	Next Extension Header Type							

Fig. 5 - prior art

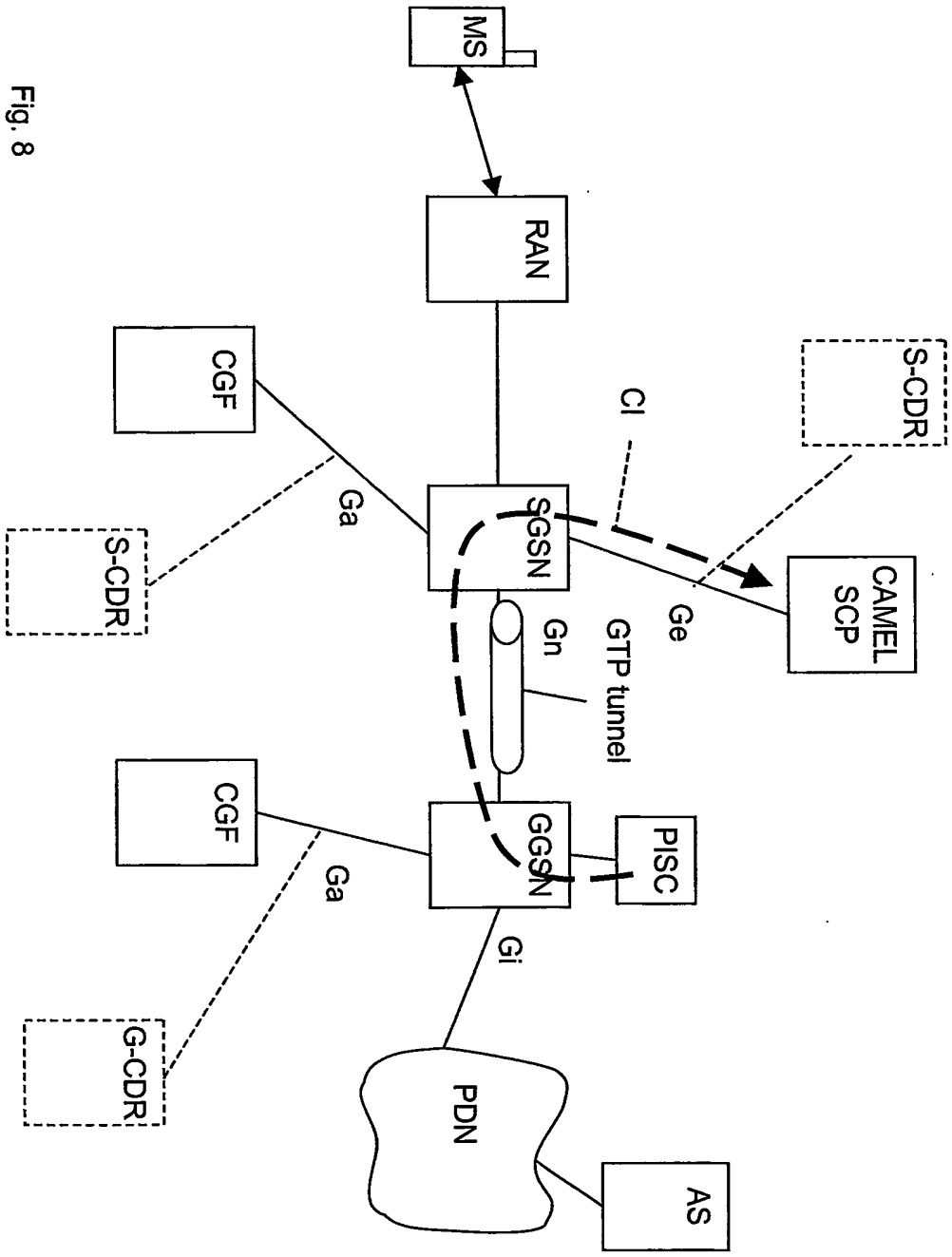
Octets	
1	Extension Header Length
2 - m	Extension Header Content
m+1	Next Extension Header Type (*)

Fig. 6 - prior art

Bits 8	Bits 7	Meaning
0	0	Comprehension of this extension header is not required. An Intermediate Node shall forward it to any Receiver Endpoint
0	1	Comprehension of this extension header is not required. An Intermediate Node shall discard the Extension Header Content and not forward it to any Receiver Endpoint. Other extension headers shall be treated independently of this extension header.
1	0	Comprehension of this extension header is required by the Endpoint Receiver but not by an Intermediate Node. An Intermediate Node shall forward the whole field to the Endpoint Receiver.
1	1	Comprehension of this header type is required by recipient (either Endpoint Receiver or Intermediate Node)

Fig. 7 - prior art

Fig. 8


MS
RAN
CGF
S-CDR
Ga
S-CDR
SGSN
CI
S-CDR
Ge
CAMEL SCP
Gn
GTP tunnel
CGF
GGSN
PISC
Ga
Gi
G-CDR
PDN
AS

Octets	1
1	
2	Main category
3	Subcategory (0 if not used)
4	Next Extension Header Type

Fig. 9

Octets	2
1	
2	Main category
3	Subcategory (0 if not used)
4 – 7	Volume count (Integer4)
8	Next Extension Header Type

Fig. 10

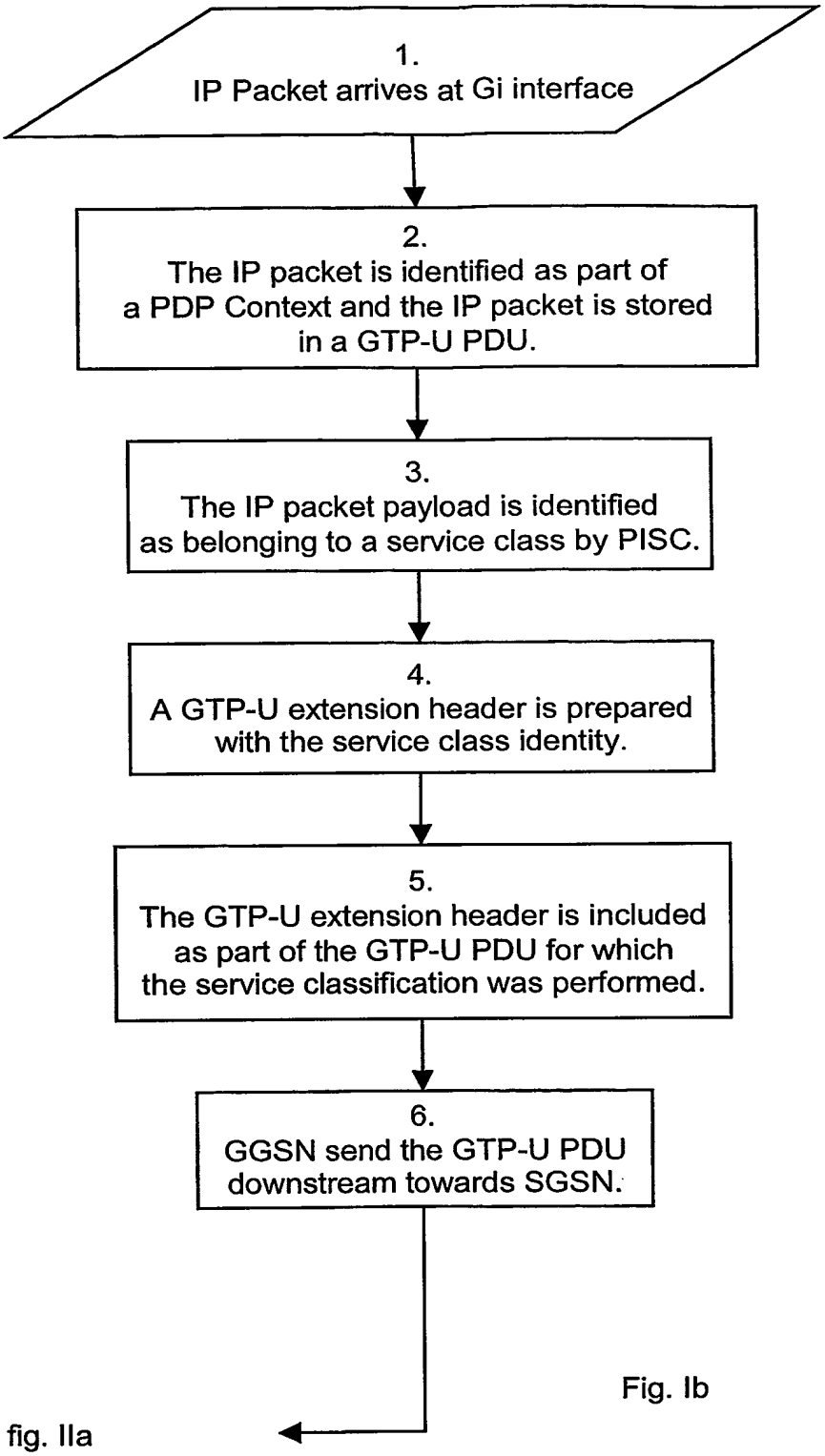

1.
IP Packet arrives at Gi interface
2.
The IP packet is identified as part of a PDP Context and the IP packet is stored in a GTP-U PDU.
3.
The IP packet payload is identified as belonging to a service class by PISC.
4.
A GTP-U extension header is prepared with the service class identity.
5.
The GTP-U extension header is included as part of the GTP-U PDU for which the service classification was performed.
6.
GGSN send the GTP-U PDU downstream towards SGSN.
to fig. IIa

Fig. Ib

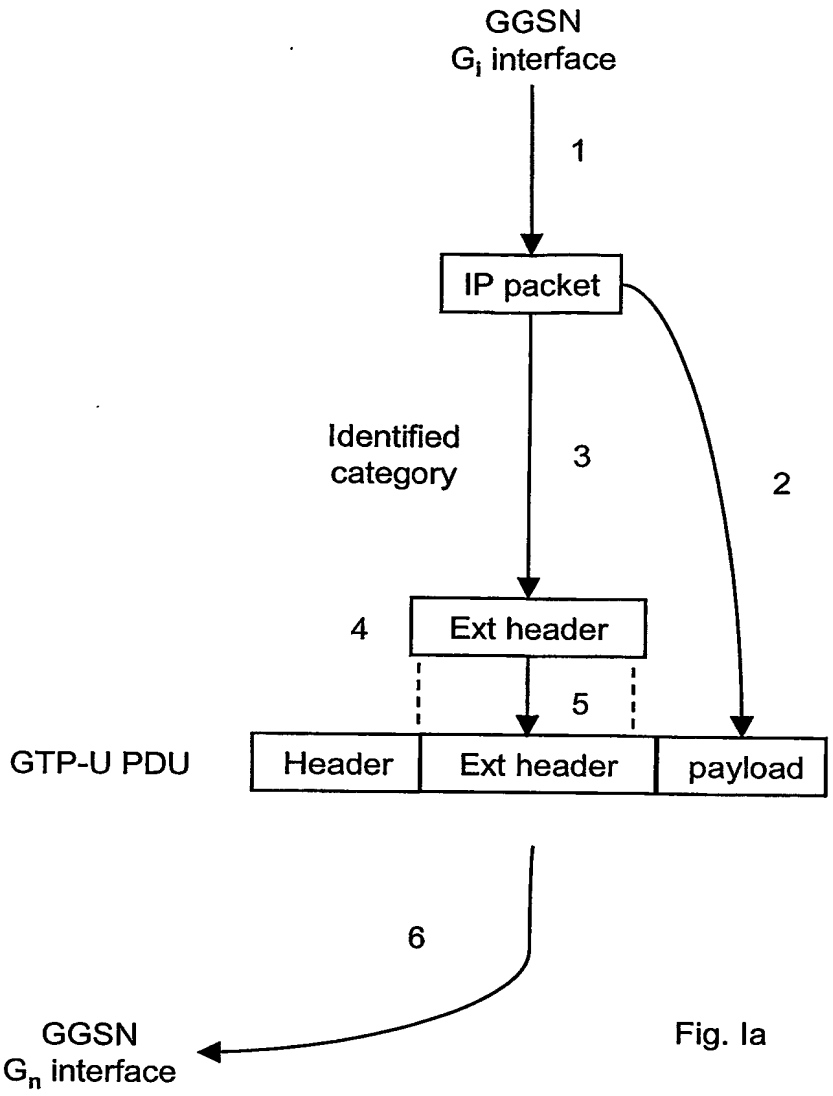

GGSN
G_i interface
1
IP packet
Identified
category
3
2
4
Ext header
5
GTP-U PDU
Header
Ext header
payload
6
GGSN
G_n interface

Fig. Ia

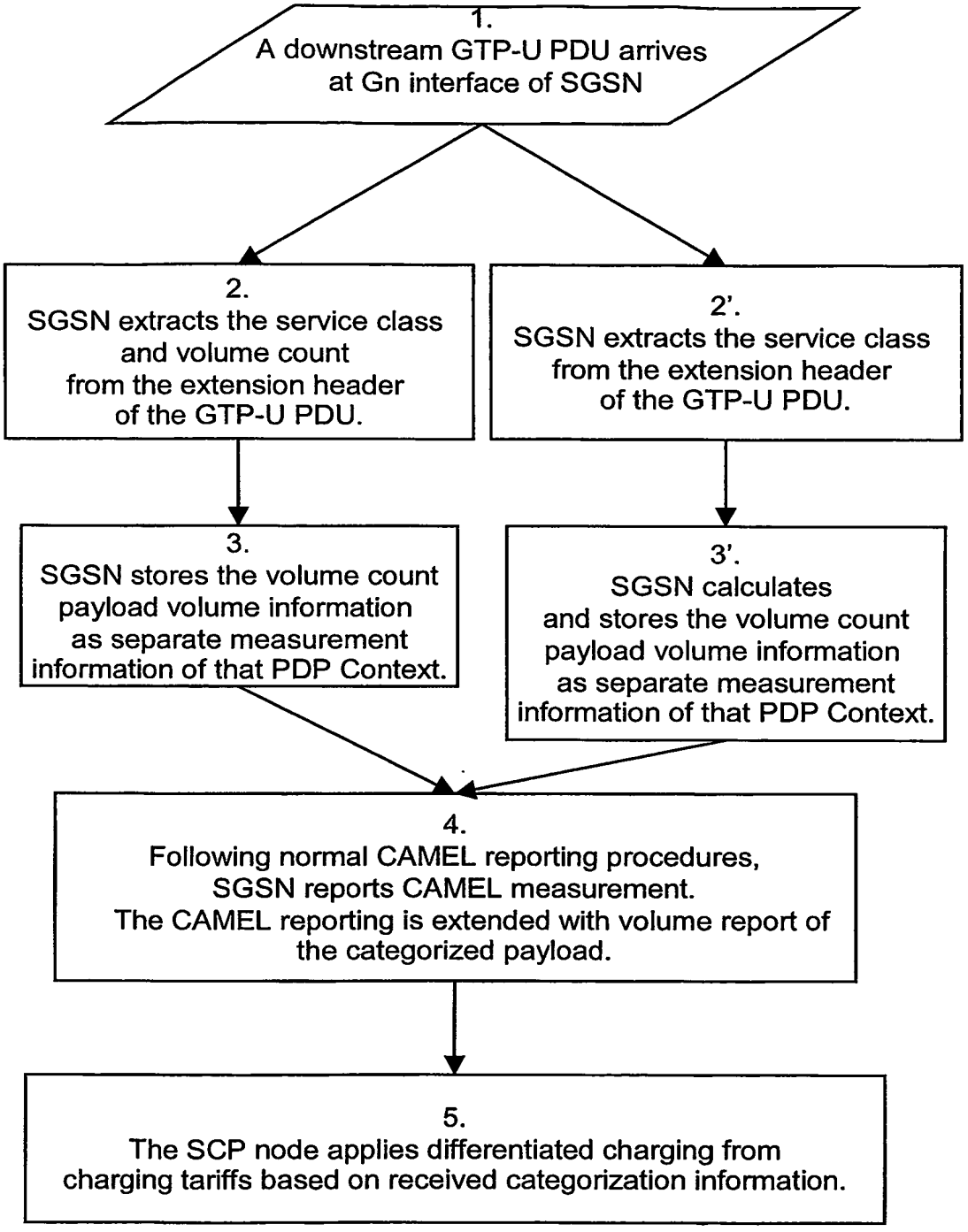

1.
A downstream GTP-U PDU arrives at Gn interface of SGSN
2.
SGSN extracts the service class and volume count from the extension header of the GTP-U PDU.
2'.
SGSN extracts the service class from the extension header of the GTP-U PDU.
3.
SGSN stores the volume count payload volume information as separate measurement information of that PDP Context.
3'.
SGSN calculates and stores the volume count payload volume information as separate measurement information of that PDP Context.
4.
Following normal CAMEL reporting procedures, SGSN reports CAMEL measurement. The CAMEL reporting is extended with volume report of the categorized payload.
5.
The SCP node applies differentiated charging from charging tariffs based on received categorization information.

Fig. IIb

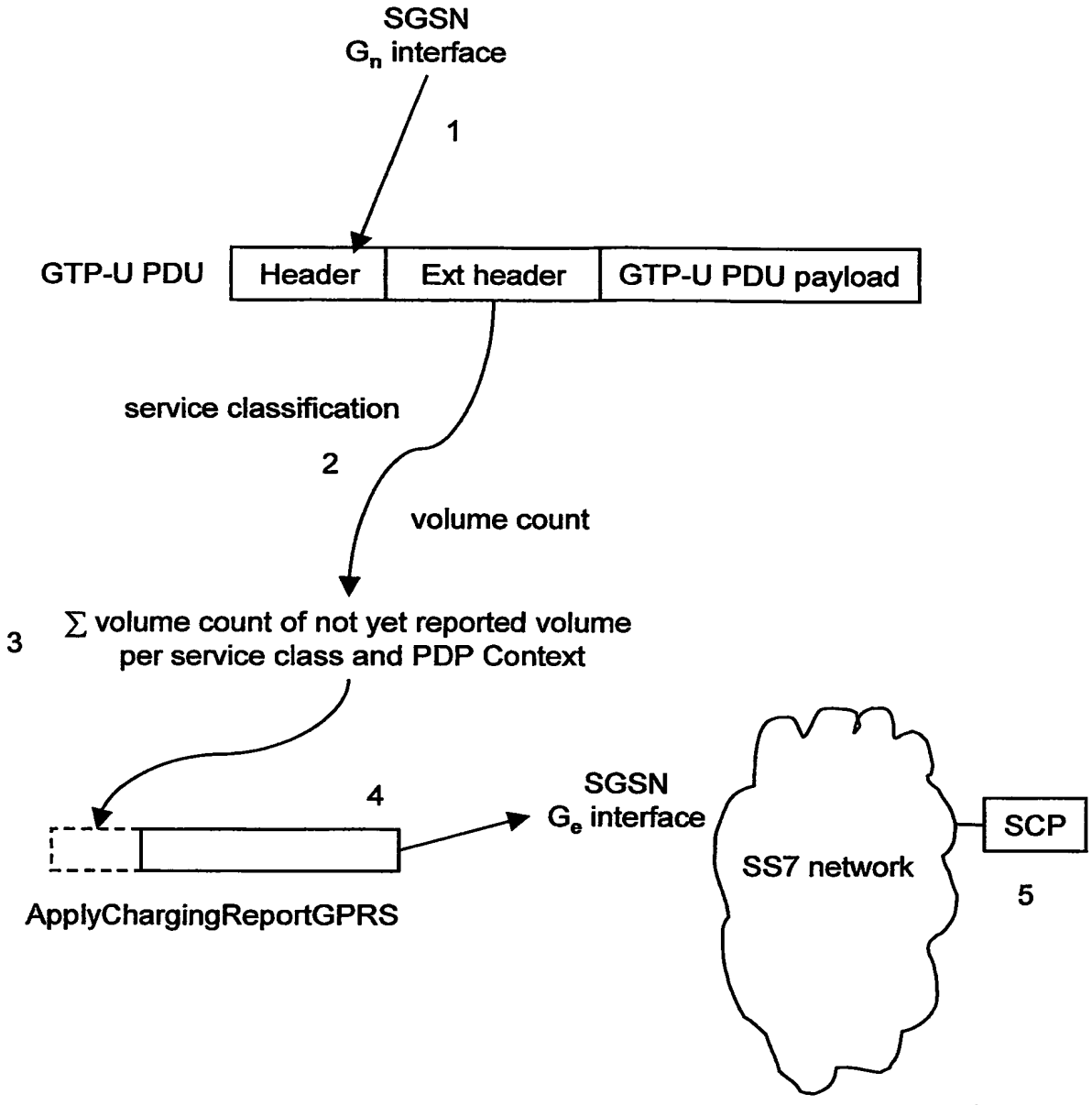

SGSN
G_n interface
1
GTP-U PDU
Header
Ext header
GTP-U PDU payload
service classification
2
volume count
3
∑ volume count of not yet reported volume per service class and PDP Context
4
SGSN
G_e interface
SS7 network
SCP
5
ApplyChargingReportGPRS

Fig.IIa

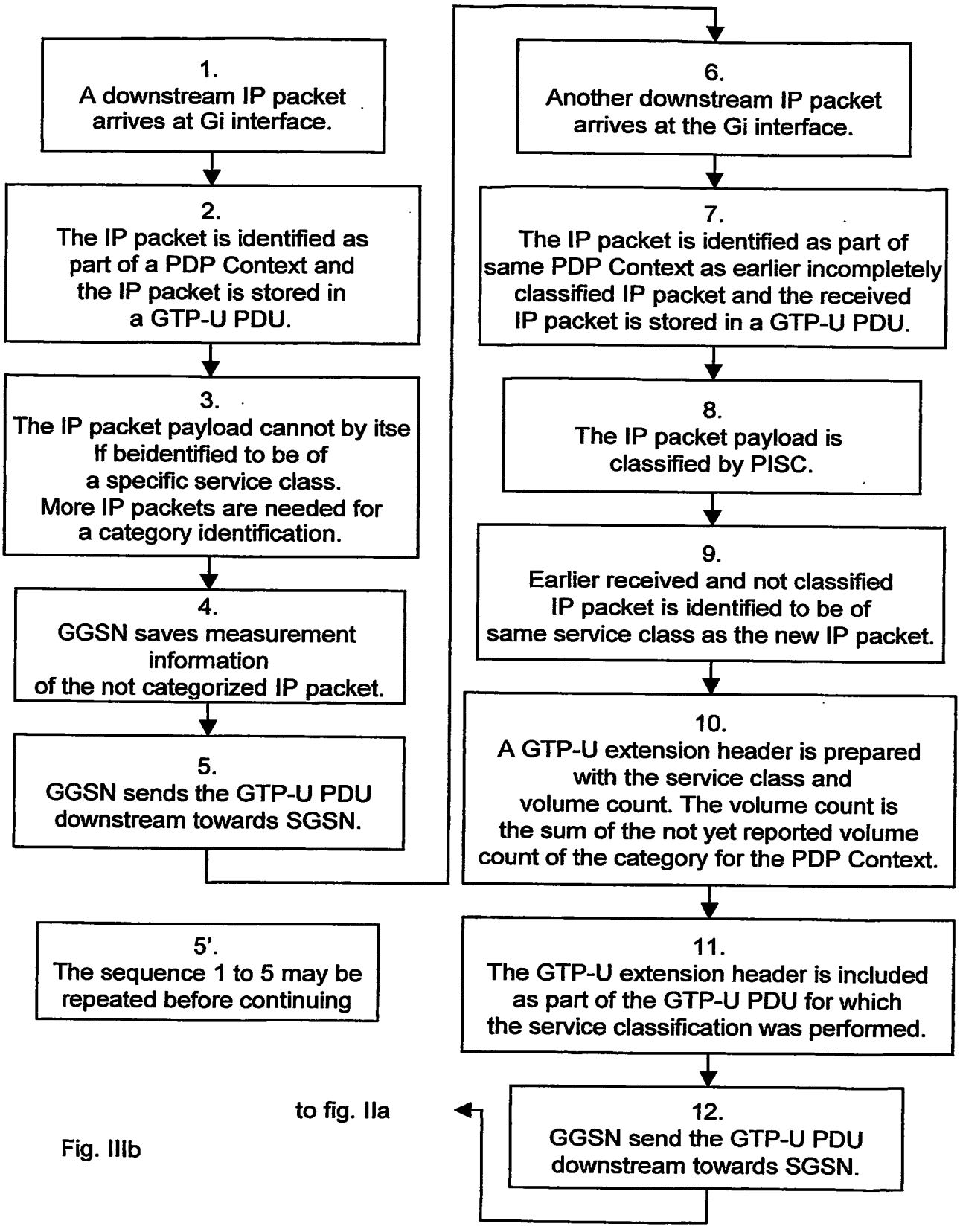

1.
A downstream IP packet arrives at Gi interface.
2.
The IP packet is identified as part of a PDP Context and the IP packet is stored in a GTP-U PDU.
3.
The IP packet payload cannot by itse If beidentified to be of a specific service class. More IP packets are needed for a category identification.
4.
GGSN saves measurement information of the not categorized IP packet.
5.
GGSN sends the GTP-U PDU downstream towards SGSN.
5'.
The sequence 1 to 5 may be repeated before continuing
6.
Another downstream IP packet arrives at the Gi interface.
7.
The IP packet is identified as part of same PDP Context as earlier incompletely classified IP packet and the received IP packet is stored in a GTP-U PDU.
8.
The IP packet payload is classified by PISC.
9.
Earlier received and not classified IP packet is identified to be of same service class as the new IP packet.
10.
A GTP-U extension header is prepared with the service class and volume count. The volume count is the sum of the not yet reported volume count of the category for the PDP Context.
11.
The GTP-U extension header is included as part of the GTP-U PDU for which the service classification was performed.
12.
GGSN send the GTP-U PDU downstream towards SGSN.
to fig. IIa

Fig. IIIb

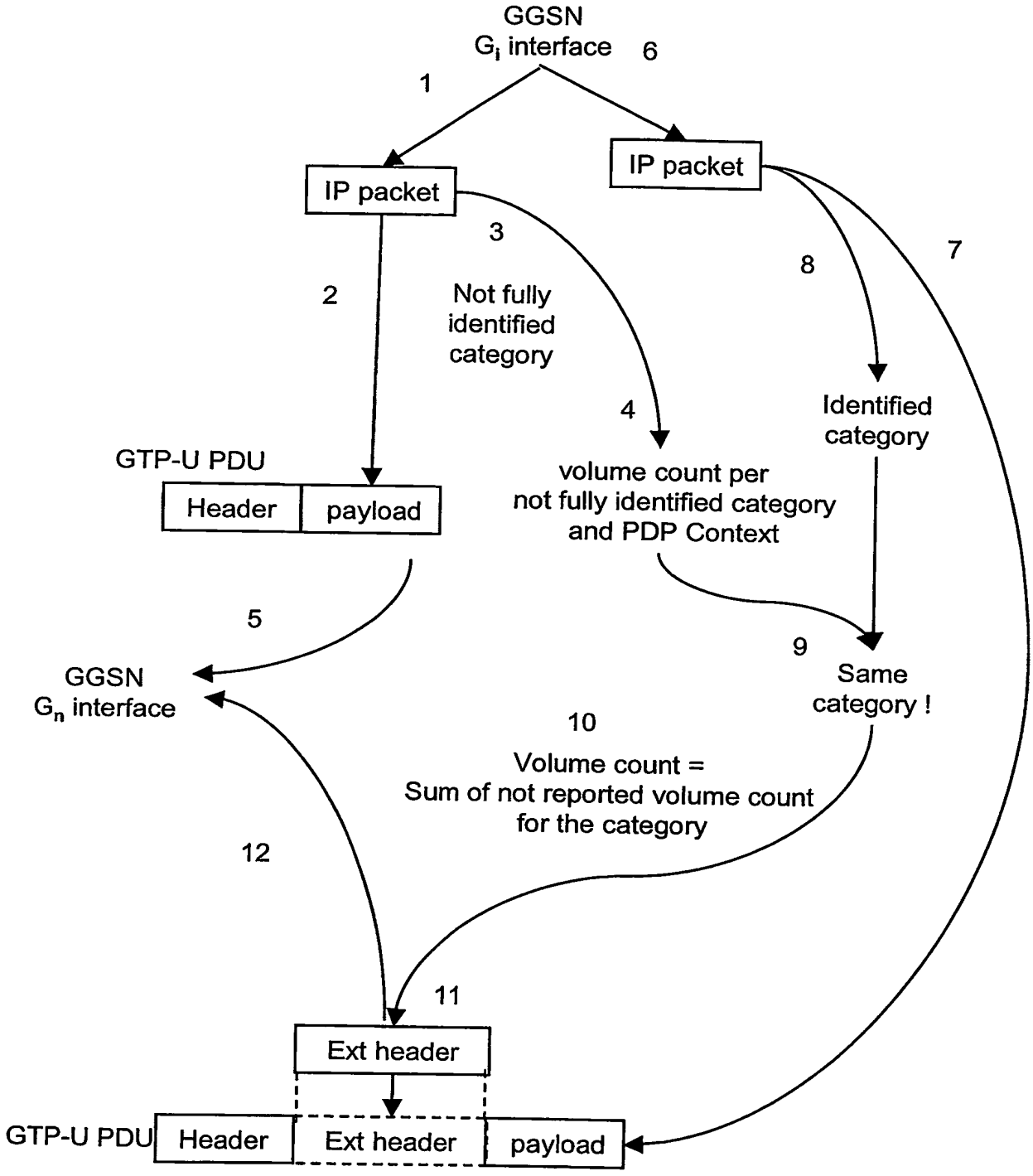

GGSN
G_i interface
1
6
IP packet
IP packet
2
3
Not fully identified category
4
7
8
Identified category
GTP-U PDU
Header
payload
volume count per not fully identified category and PDP Context
5
9
GGSN
G_n interface
Same category !
10
Volume count = Sum of not reported volume count for the category
12
11
Ext header
GTP-U PDU
Header
Ext header
payload

Fig. IIIa

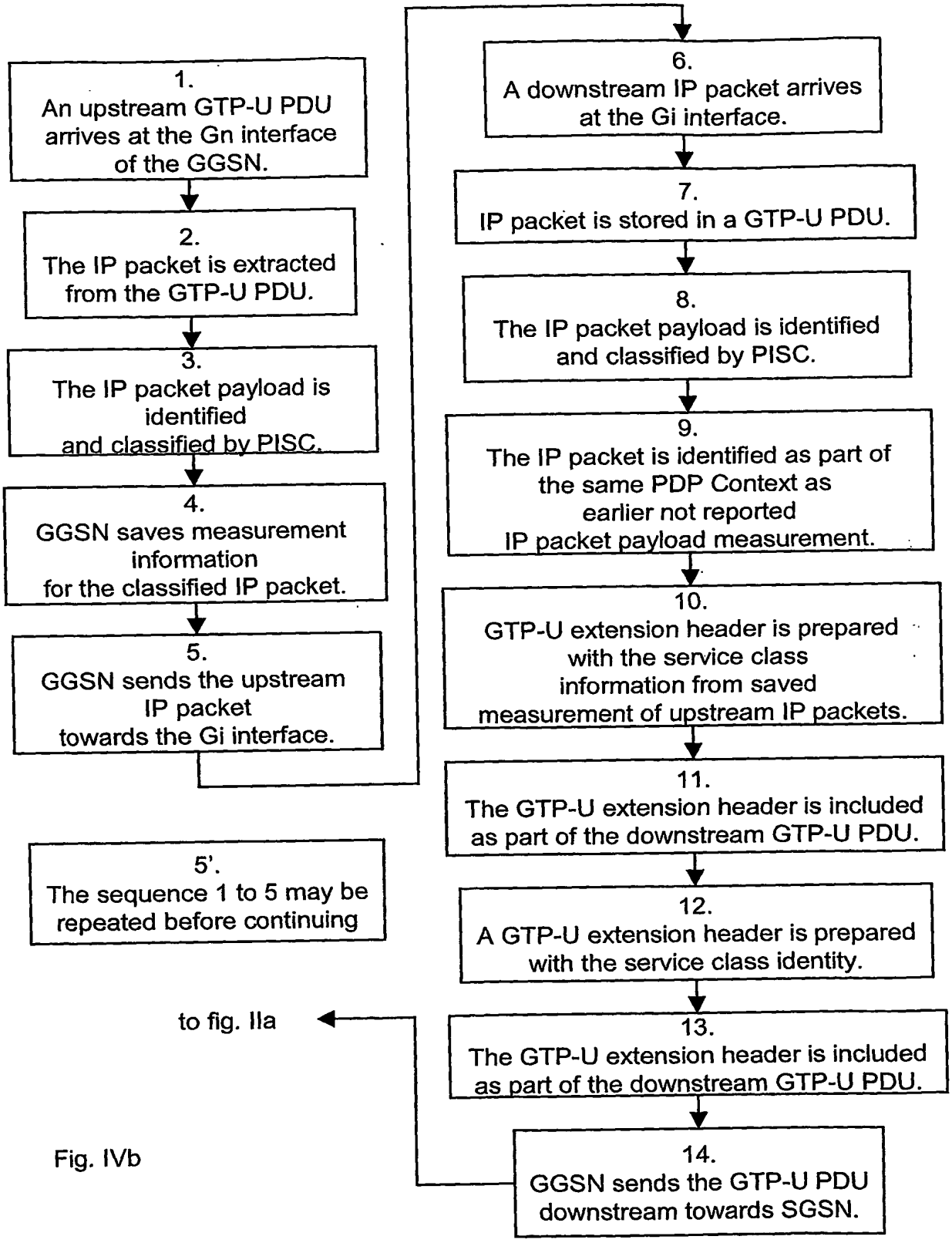

1.
An upstream GTP-U PDU arrives at the Gn interface of the GGSN.
2.
The IP packet is extracted from the GTP-U PDU.
3.
The IP packet payload is identified and classified by PISC.
4.
GGSN saves measurement information for the classified IP packet.
5.
GGSN sends the upstream IP packet towards the Gi interface.
5'.
The sequence 1 to 5 may be repeated before continuing
6.
A downstream IP packet arrives at the Gi interface.
7.
IP packet is stored in a GTP-U PDU.
8.
The IP packet payload is identified and classified by PISC.
9.
The IP packet is identified as part of the same PDP Context as earlier not reported IP packet payload measurement.
10.
GTP-U extension header is prepared with the service class information from saved measurement of upstream IP packets.
11.
The GTP-U extension header is included as part of the downstream GTP-U PDU.
12.
A GTP-U extension header is prepared with the service class identity.
13.
The GTP-U extension header is included as part of the downstream GTP-U PDU.
14.
GGSN sends the GTP-U PDU downstream towards SGSN.
to fig. IIa

Fig. IVb

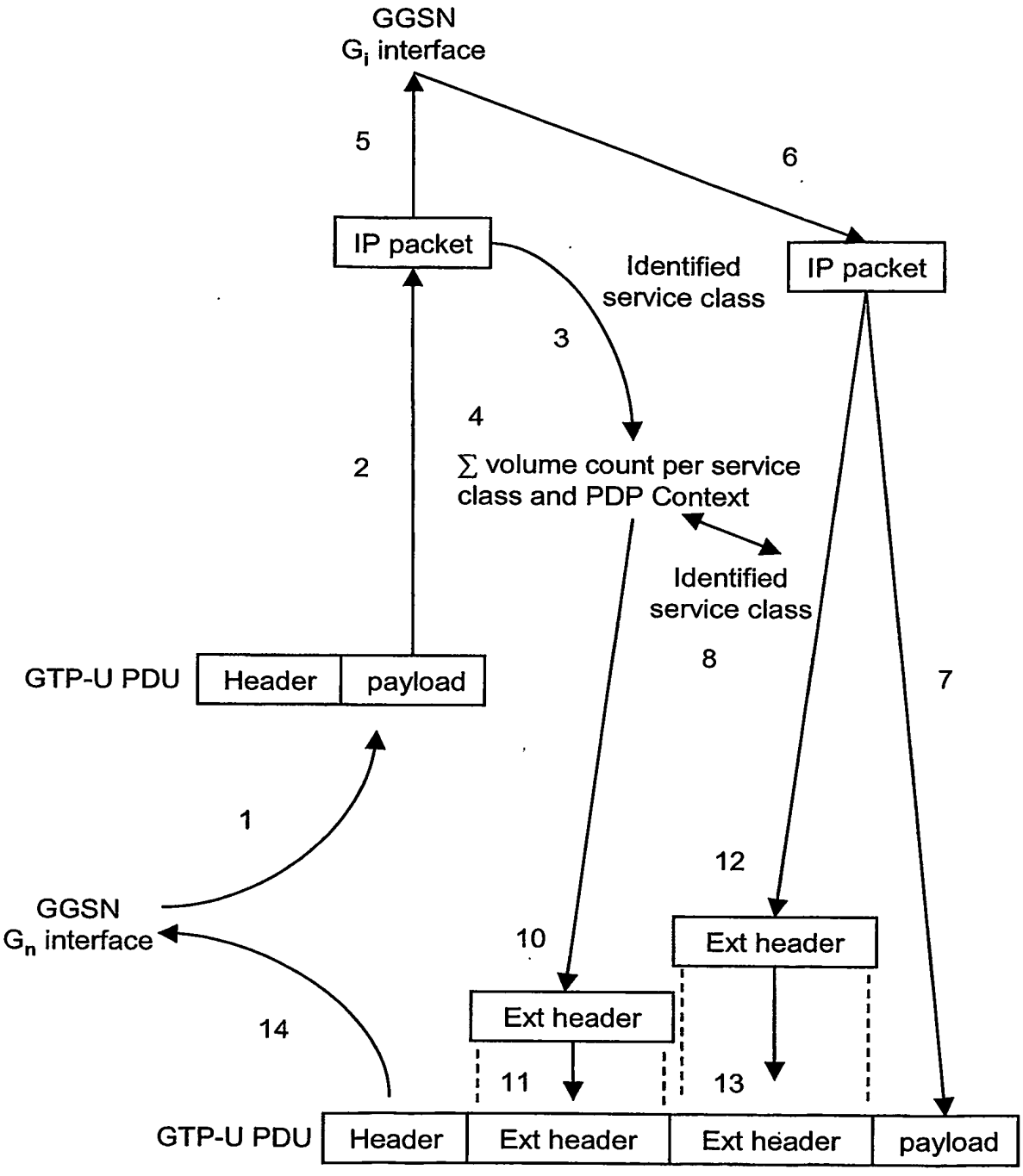

GGSN
G_i interface
5
6
IP packet
Identified
service class
IP packet
3
4
2
∑ volume count per service
class and PDP Context
Identified
service class
8
7
GTP-U PDU
Header
payload
1
12
GGSN
G_n interface
10
Ext header
Ext header
14
11
13
GTP-U PDU
Header
Ext header
Ext header
payload

Fig. IVa